PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-115730
(43)Date of publication of application : 02.05.1995

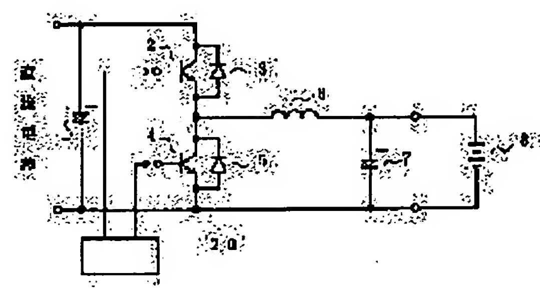
(51)Int.Cl. H02J 7/00
H02M 3/155

(21)Application number : 05-257366
(22)Date of filing : 15.10.1993

(71)Applicant : FUJI ELECTRIC CO LTD
(72)Inventor : YONEDA KAZUO

(54) CONTROL OF CHARGING/DISCHARGING CIRCUIT OF STORAGE BATTERY AND CONTROLLER THEREOF

(57)Abstract:
PURPOSE: To make the reactor of a step-up/step-down chopper compact by operating the step-up/step-clown chopper at a high switching frequency at the time of charging of a storage battery and at a low switching frequency at the time of discharging.
CONSTITUTION: The ratio between the repeating frequency of the signal from a controller 20, which is imparted to the base of a transistor 2 performing ON/OFF operation in charging, and the repeating frequency of the signal from the controller, which is imparted to the base of a transistor 4 performing ON/ OFF operation in discharging, is determined with the built-in frequency divider in the controller 20 in the main circuit part of a step-up/step-clown chopper. Thus, the purpose is achieved.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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CLAIMS

[Claim(s)]
[Claim 1] The control approach of the charge-and-discharge circuit of the battery characterized by operating said step-down and step-up chopper in the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery on a switching frequency which is different, respectively at the time of charge of said battery, and discharge.
[Claim 2] The control approach of the charge-and-discharge circuit of the battery according to claim 1 characterized by operating a step-down and step-up chopper on a low switching frequency with a high switching frequency at the time of discharge at the time of charge of a battery.
[Claim 3] In the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery The oscillator which oscillates the switching frequency at the time of charge of a battery, and the 1st triangular wave converter which changes the output of said oscillator into a triangular wave, The 1st comparator which compares said the 1st output and charge control signal of a triangular wave converter, and operates, The controller of the charge-and-discharge circuit of the battery characterized by coming to have the 2nd comparator which compares the output and discharge control signal of the counting-down circuit which carries out dividing of the output of said oscillator, the 2nd triangular wave converter which changes the output of said counting-down circuit into a triangular wave, and said 2nd triangular wave converter, and operates.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the control approach of the charge-and-discharge circuit of the battery at the time of having a battery, for example, constituting no cutting-off-the electric current-ization of an adjustable electrical potential difference and a variable frequency (VVVF) inverter, and its controller.
[0002]
[Description of the Prior Art] What is indicated by JP,5-122865,A is known as a charge-and-discharge circuit of the conventional battery. The charge-and-discharge circuit of this battery is explained based on the circuit diagram of drawing 4 . In drawing 4 , the capacitor by which 1 is connected to DC power supply and juxtaposition, the capacitor by which diode and 6 are connected to a reactor and 7 is connected [2 and 4] to a battery 8 and juxtaposition for a transistor, and 3 and 5, and 10 are controllers which control the base of transistors 2 and 4, and the main circuit section of a step-down and step-up chopper consists of 1-7.
[0003] At the time of charge of a battery 8, a transistor 4 is made off, in order to make a transistor 2 turn on and off, an on-off signal is given to the base of a transistor 2, at the time of discharge of a battery 8, a transistor 2 is made off, and in order to make a transistor 4 turn on and off, he is trying to give an on-off signal to the base of a transistor 4 from a controller 10. In that case, the repeat frequency of the on-off signal to the base of a transistor 2 or a transistor 4, i.e., the switching frequency of a step-down and step-up chopper, is fixed, and the request is controlled by adjusting an on-off ratio.
[0004]
[Problem(s) to be Solved by the Invention] In the charge-and-discharge circuit of the conventional battery, pulsation (ripple) of said charging current becomes large, since it is not desirable for a battery, the inductance value of said reactor is enlarged and the current of said reactor is usually made not intermittent [compared with the time of discharge, / since the charging current is small, the current of the reactor (sign 6 reference of drawing 4) of the main circuit section of a step-down and step-up chopper is intermittent consequently] at the time of charge.
[0005] Therefore, said reactor was enlarged, and since the inductance value was large, when sudden change occurred for the load by the side of DC power supply at the time of discharge, there was a problem that fluctuation of the output voltage by the side of DC power supply became large. Moreover, in order to control fluctuation of the output voltage by the side of said DC power supply, there was also a problem that the capacity of the capacitor by the side of DC power supply (sign 1 reference of drawing 4) became large.
[0006] The technical problem of this invention miniaturizes said reactor, and is to control fluctuation of the output voltage at the time of sudden change of the load by the side of DC power supply.
[0007]
[Means for Solving the Problem] In order to solve this technical problem, in this invention, in the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery, it is a switching frequency high at the time of charge of a battery, and a step-down and step-up chopper is operated on a low switching frequency at the time of discharge.
[0008] Moreover, the oscillator with which the controller of the charge-and-discharge circuit of a battery oscillates the switching frequency at the time of charge of a battery, The 1st comparator which compares the output and charge control signal of the 1st triangular wave converter which changes the output of said oscillator

into a triangular wave, and said 1st triangular wave converter, and operates, It has the 2nd comparator which compares the output and discharge control signal of the counting-down circuit which carries out dividing of the output of said oscillator, the 2nd triangular wave converter which changes the output of said counting-down circuit into a triangular wave, and said 2nd triangular wave converter, and operates.

[0009]

[Function] In the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery at the time of charge of a battery, on a high switching frequency In operating a step-down and step-up chopper on a low switching frequency at the time of discharge, at the time of charge The current of the reactor (sign 6 reference of drawing 4) of the main circuit section of a step-down and step-up chopper continues. Consequently, since pulsation (ripple) of said charging current becomes small, serves as the suitable charging current for a battery and can make the inductance value of said reactor small at the time of discharge, even if the load by the side of DC power supply changes suddenly, fluctuation of the output voltage by the side of DC power supply can be suppressed small.

[0010]

[Example] The circuit diagram of the example of this invention is shown in drawing 1 . In drawing 1 R> 1, the same sign is given to what has the same function as drawing 4 , explanation is omitted, and it explains focusing on the thing of a different function from drawing 4 . That is, in drawing 1 , the controller of the former [controller / 20] is equipped with different circuitry, and is as the detail being shown in drawing 2 .

[0011] The oscillator 21 which drawing 2 is the circuit diagram of the controller of the charge-and-discharge circuit of the battery by this invention, and oscillates the switching frequency at the time of charge of a battery, The comparator 23 which compares with the output and charge control signal of the triangular wave converter 22 the triangular wave converter 22 which changes the output of an oscillator 21 into a triangular wave, and operates, It consists of comparators 26 which compare with the output and discharge control signal of the triangular wave converter 25 the counting-down circuit 24 which carries out dividing of the output of an oscillator 21, and the triangular wave converter 25 which changes the output of a counting-down circuit 24 into a triangular wave, and operate.

[0012] The wave form chart of drawing 3 explains actuation of the controller of the charge-and-discharge circuit of drawing 2 , referring to drawing 1 and the name of drawing 2 , and a sign. In this drawing, at the time of charge of the battery 8 shown in (**) of drawing 3 , the output of a comparator 23, i.e., the base signal of a transistor 2, repeats turning on and off like (**) of drawing 3 , the output of a comparator 26, i.e., the base signal of a transistor 4, continues an OFF state like (Ha) of drawing 3 , and the on-off ratio at this time is adjusted by the comparator 23 by the level of a charge control signal and the output of the triangular wave converter 22 which are shown in drawing 2 . Moreover, at the time of discharge of the battery 8 shown in (**) of drawing 3 , the output of a comparator 26, i.e., the base signal of a transistor 4, repeats turning on and off like (Ha) of drawing 3 , the output of a comparator 23, i.e., the base signal of a transistor 2, continues an OFF state like (b) of drawing 3 , and the on-off ratio at this time is adjusted by the comparator 26 by the level of a discharge control signal and the output of the triangular wave converter 25 which are shown in drawing 2 . The ratio of the repeat frequency of turning on and off of (**) of drawing 3 and the repeat frequency of turning on and off of (Ha) of drawing 3 is determined by the counting-down circuit 24.

[0013] In drawing 2 , although the repeat frequency of turning on and off at the time of discharge is decided with the oscillator 21 and the counting-down circuit 24 which carries out dividing of the output of an oscillator 21, it is also possible to constitute the function equivalent to an oscillator 21 and a counting-down circuit 24 from an oscillator with an another oscillator 21. Moreover, as for all, the bipolar transistor which has self-extinction of arc capacity, a field-effect transistor, an insulated gate transistor (IGBT), etc. are usable as a switching semiconductor device of the main circuit section of a step-down and step-up chopper.

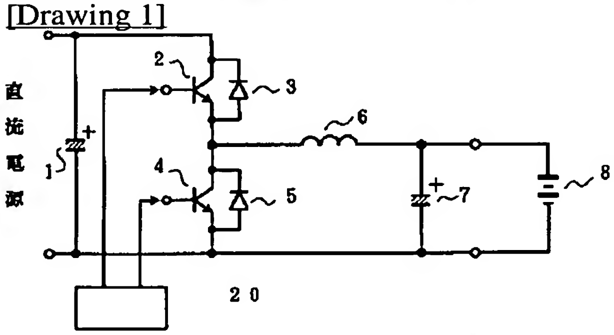
[0014]

[Effect of the Invention] By this invention, by increasing the switching frequency of the step-down and step-up chopper for example, at the time of charge 5 times of the switching frequency of the step-down and step-up chopper at the time of discharge, the inductance value of a reactor can be set to about 1/5 compared with the former, the miniaturization of a reactor can be measured, and a miniaturization and cost cut of a battery of a charge-and-discharge circuit can be performed.

[Translation done.]

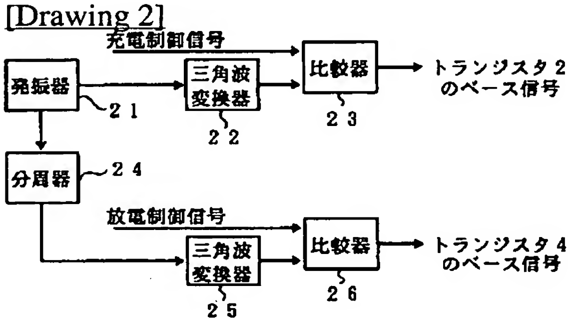
DRAWINGS

[Drawing 1]

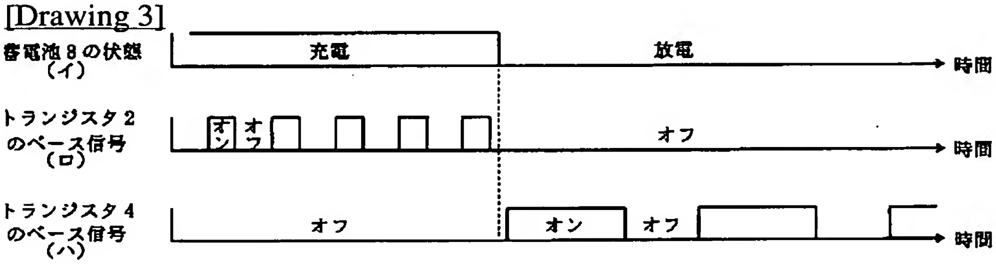


1：コンデンサ，2：トランジスタ，3：ダイオード
4：トランジスタ，5：ダイオード，6：リアクトル
7：コンデンサ，8：蓄電池，20：制御器

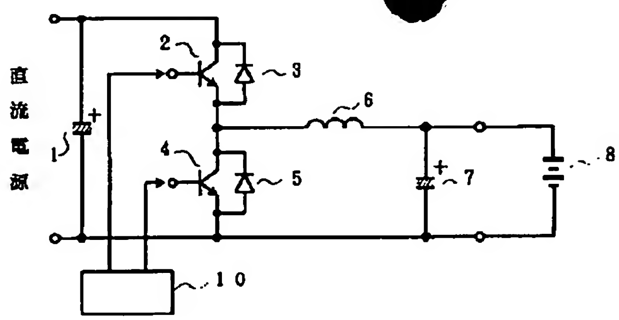
[Drawing 2]



[Drawing 3]



[Drawing 4]



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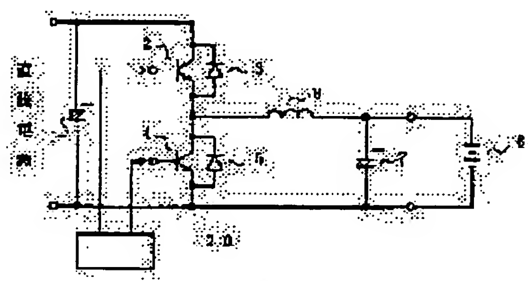

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[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

(19)日本国特許庁（JP）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－115730

(43)公開日　平成7年(1995)5月2日

(51)Int.Cl.⁶		識別記号	庁内整理番号	F I	技術表示箇所
H02J	7/00	L			
H02M	3/155	S	8726－5H		

審査請求　未請求　請求項の数3　OL　(全 4 頁)

(21)出願番号　特願平5－257366

(22)出願日　平成5年(1993)10月15日

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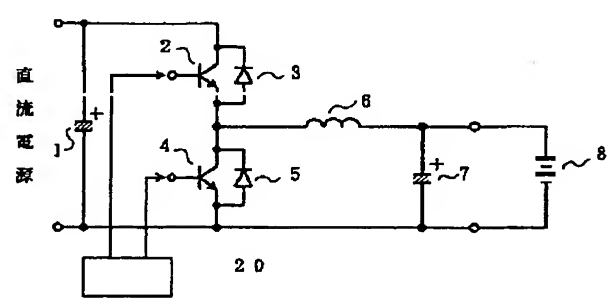
(54)【発明の名称】　蓄電池の充放電回路の制御方法およびその制御器

(57)【要約】

【目的】蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させることで、前記昇降圧チョッパのリアクトルを小型化する。

【構成】昇降圧チョッパの主回路部において、充電時にオン・オフ動作するトランジスタ２のベースに与える制御器２０からの信号の繰り返し周波数と、放電時にオン・オフ動作をするトランジスタ４のベースに制御器２０からの信号の繰り返し周波数の比率を制御器２０に内蔵する分周器で決めることで、上記目的を達成する構成。



１：コンデンサ，２：トランジスタ，３：ダイオード
４：トランジスタ，５：ダイオード，６：リアクトル
７：コンデンサ，８：蓄電池，２０：制御器

【特許請求の範囲】

【請求項１】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、前記蓄電池の充電時と、放電時とにそれぞれ異なったスイッチング周波数で前記昇降圧チョッパを動作させることを特徴とする蓄電池の充放電回路の制御方法。

【請求項２】蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させることを特徴とする請求項１に記載の蓄電池の充放電回路の制御方法。

【請求項３】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時のスイッチング周波数を発振する発振器と、前記発振器の出力を三角波に変換する第１の三角波変換器と、前記第１の三角波変換器の出力と充電制御信号とを比較して動作する第１の比較器と、前記発振器の出力を分周する分周器と、前記分周器の出力を三角波に変換する第２の三角波変換器と、前記第２の三角波変換器の出力と放電制御信号とを比較して動作する第２の比較器とを備えてなることを特徴とする蓄電池の充放電回路の制御器。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、蓄電池を備えて、例えば、可変電圧・可変周波数（ＶＶＶＦ）インバータの無停電化を構成する際の蓄電池の充放電回路の制御方法およびその制御器に関する。

【０００２】

【従来の技術】従来の蓄電池の充放電回路として、例えば特開平５－１２２８６５号公報に開示されているものが知られている。この蓄電池の充放電回路を図４の回路図に基づいて説明する。図４において、１は直流電源と並列に接続されるコンデンサ、２，４はトランジスタ、３，５はダイオード、６はリアクトル、７は蓄電池８と並列に接続されるコンデンサ、１０はトランジスタ２，４のベースを制御する制御器であり、１～７で昇降圧チョッパの主回路部が構成されている。

【０００３】制御器１０より、蓄電池８の充電時にはトランジスタ４をオフとし、トランジスタ２をオン・オフさせるためにトランジスタ２のベースにオン・オフ信号を与え、蓄電池８の放電時にはトランジスタ２をオフとし、トランジスタ４をオン・オフさせるためにトランジスタ４のベースにオン・オフ信号を与えるようにしている。その際、トランジスタ２またはトランジスタ４のベースへのオン・オフ信号の繰り返し周波数すなわち昇降圧チョッパのスイッチング周波数は一定で、オン・オフ比を調節することで所望の制御を行っている。

【０００４】

【発明が解決しようとする課題】従来の蓄電池の充放電回路では、充電時には、放電時に比べて、充電電流が小さいため昇降圧チョッパの主回路部のリアクトル（図４の符号６参照）の電流が断続し、その結果、前記充電電流の脈動（リプル）が大きくなり蓄電池にとって好ましくないため、通常、前記リアクトルのインダクタンス値を大きくして前記リアクトルの電流を断続しないようにしている。

【０００５】そのため、前記リアクトルが大型化し、インダクタンス値が大きいため、放電時に直流電源側の負荷に急変が発生すると直流電源側の出力電圧の変動が大きくなるという問題があった。また、前記直流電源側の出力電圧の変動を抑制するため直流電源側のコンデンサ（図４の符号１参照）の容量が大きくなるという問題もあった。

【０００６】この発明の課題は、前記リアクトルを小型化し、直流電源側の負荷の急変時の出力電圧の変動を抑制することにある。

【０００７】

【課題を解決するための手段】この課題を解決するために、この発明では、蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させるものである。

【０００８】また、蓄電池の充放電回路の制御器は、蓄電池の充電時のスイッチング周波数を発振する発振器と、前記発振器の出力を三角波に変換する第１の三角波変換器と、前記第１の三角波変換器の出力と充電制御信号とを比較して動作する第１の比較器と、前記発振器の出力を分周する分周器と、前記分周器の出力を三角波に変換する第２の三角波変換器と、前記第２の三角波変換器の出力と放電制御信号とを比較して動作する第２の比較器とを備えるものである。

【０００９】

【作用】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させることで、充電時には、昇降圧チョッパの主回路部のリアクトル（図４の符号６参照）の電流が連続し、その結果、前記充電電流の脈動（リプル）が小さくなり蓄電池にとって好適な充電電流となり、放電時には前記リアクトルのインダクタンス値を小さくできるため、直流電源側の負荷が急変しても直流電源側の出力電圧の変動を小さく抑えられる。

【００１０】

【実施例】図１にこの発明の実施例の回路図を示す。図１において、図４と同一機能を有するものには同一符号を付して説明を省略し、図４と異なる機能のものを中心

に説明する。すなわち図１において、制御器２０は従来の制御器とは異なった回路構成を備えており、その詳細は図２に示す通りである。

【００１１】図２はこの発明による蓄電池の充放電回路の制御器の回路図であり、蓄電池の充電時のスイッチング周波数を発振する発振器２１と、発振器２１の出力を三角波に変換する三角波変換器２２と、三角波変換器２２の出力と充電制御信号とを比較して動作する比較器２３と、発振器２１の出力を分周する分周器２４と、分周器２４の出力を三角波に変換する三角波変換器２５と、三角波変換器２５の出力と放電制御信号とを比較して動作する比較器２６とで構成されている。

【００１２】図２の充放電回路の制御器の動作を、図１および図２の名称，符号を参照しつつ、図３の波形図により説明する。同図において、図３の（イ）に示す蓄電池８の充電時には比較器２３の出力すなわちトランジスタ２のベース信号は図３の（ロ）の如くオン・オフを繰り返し、比較器２６の出力すなわちトランジスタ４のベース信号は図３の（ハ）の如くオフ状態を続け、このときのオン・オフ比は図２に示す充電制御信号のレベルと三角波変換器２２の出力とにより比較器２３で調整される。また、図３の（イ）に示す蓄電池８の放電時には比較器２６の出力すなわちトランジスタ４のベース信号は図３の（ハ）の如くオン・オフを繰り返し、比較器２３の出力すなわちトランジスタ２のベース信号は図３の（ロ）の如くオフ状態を続け、このときのオン・オフ比は図２に示す放電制御信号のレベルと三角波変換器２５の出力とにより比較器２６で調整される。図３の（ロ）のオン・オフの繰り返し周波数と、図３の（ハ）のオン・オフの繰り返し周波数との比率は分周器２４で決定される。

【００１３】図２においては、発振器２１と、発振器２１の出力を分周する分周器２４とで放電時のオン・オフの繰り返し周波数を決めているが、発振器２１と分周器２４に相当する機能を発振器２１とは別の発振器で構成することも可能である。また、昇降圧チョッパの主回路部のスイッチング半導体素子として、自己消弧能力を有するバイポーラトランジスタ、電界効果トランジスタ、絶縁ゲートトランジスタ（ＩＧＢＴ）等いずれも使用可能である。

【００１４】

【発明の効果】この発明により、例えば、充電時の昇降圧チョッパのスイッチング周波数を放電時の昇降圧チョッパのスイッチング周波数の５倍にすることにより、リアクトルのインダクタンス値を従来に比べて約５分の１にすることができ、リアクトルの小型化が計れ、蓄電池の充放電回路の小型化とコストダウンができる。

【図面の簡単な説明】

【図１】この発明の実施例を示す回路図

【図２】図１の制御器を示す回路図

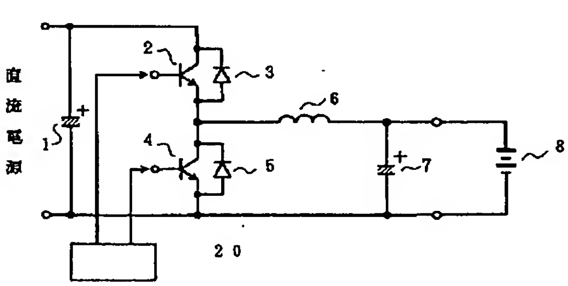
【図３】図２の動作を説明する波形図

【図４】従来例を示す回路図

【符号の説明】

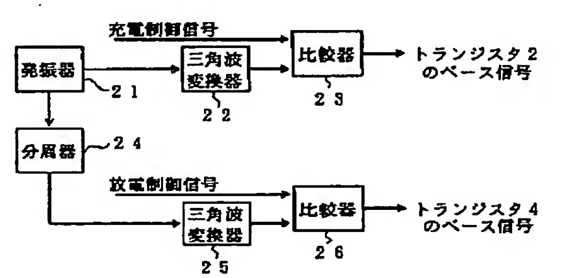
１，７　コンデンサ
２，４　トランジスタ
３，５　ダイオード
６　リアクトル
８　蓄電池
１０，２０　制御器
２１　発振器
２２，２５　三角波変換器
２３，２６　比較器
２４　分周器

【図１】

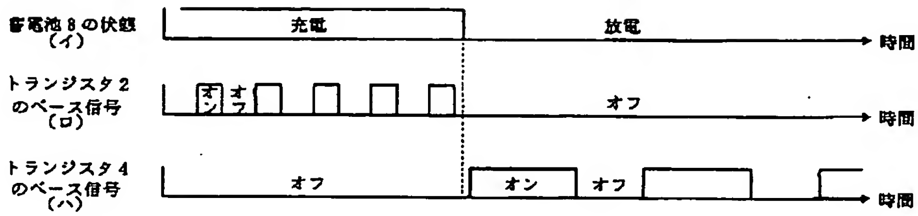


１：コンデンサ，２：トランジスタ，３：ダイオード
４：トランジスタ，５：ダイオード，６：リアクトル
７：コンデンサ，８：蓄電池，２０：制御器

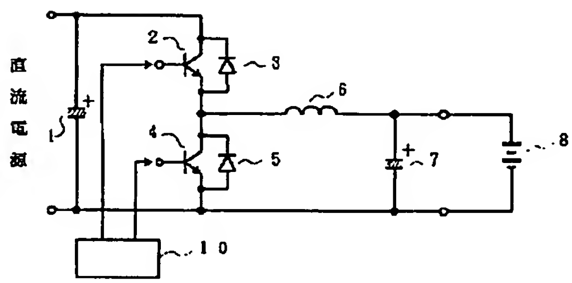
【図２】



【図3】


蓄電池8の状態
(イ)
充電
放電
時間
トランジスタ2
のベース信号
(ロ)
オン
オフ
オフ
時間
トランジスタ4
のベース信号
(ハ)
オフ
オン
オフ
時間

【図4】


直
流
電
源
1
2
3
4
5
6
7
8
10